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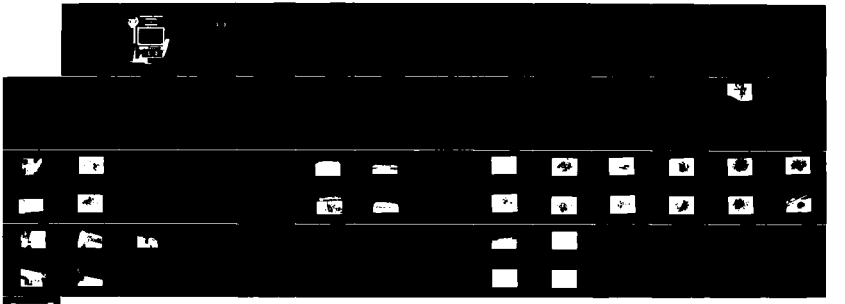

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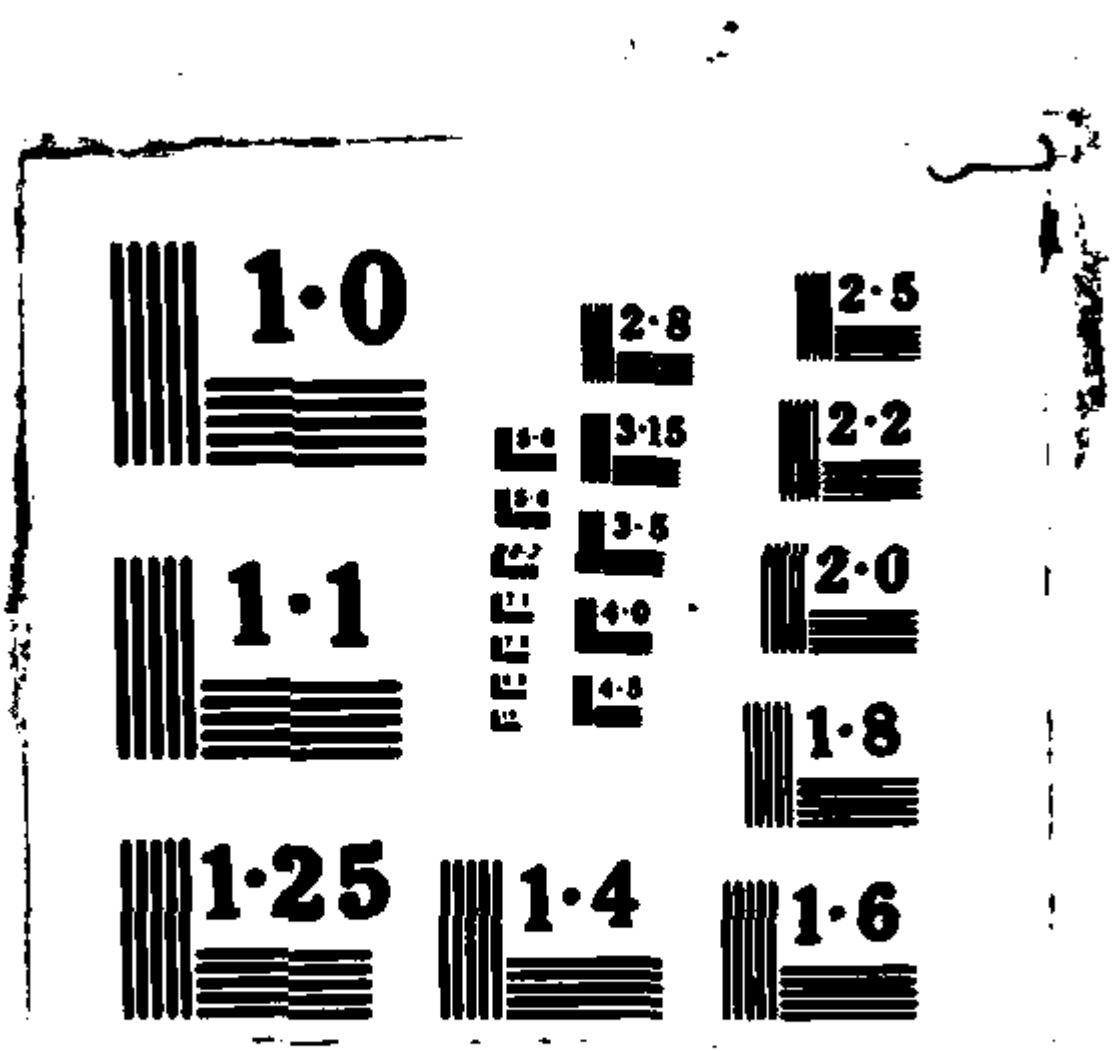
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UNDERWATER FACILITIES INSPECTION AND ASSESSMENT AT

ARDM

NAVAL SUBMARINE BASE KINGS BAY, GEORGIA

FPO-1-85(19) JUNE, 1985

PERFORMED FOR:

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C. 20374

UNDER:

CONTRACT N62477-85-D-0084
TASK 1

BY:

COLLINS ENGINEERS, INC.
600 WEST JACKSON BOULEVARD
CHICAGO, ILLINOIS 60606

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19. ABSTRACT (Continue on reverse if necessary & identify by block number)
The underwater inspection of the Floating Dry Dock Mooring Facility (ARDM) at the Naval Submarine Base at Kings Bay, Georgia, performed in June, 1985, indicated that the facility is generally in excellent condition.
Both the pier & the spud dolphin are in excellent condition below water.(Con't)

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BLOCK 19 (Con't)

No underwater repairs are warranted at this time. There are, however, exposed and corroded steel wire lifting loops on the piles below water that could provide an area where future deterioration of the piles could begin. It is planned to remove some of the piles at the ARDM facility in the near future as part of planned improvements. It is recommended that those piles be inspected internally to determine if the corrosion extends into the piles, and to determine if removal of the loops and patching is necessary to maintain the structures.

Minor localized areas of chipped, scaled, and cracked concrete were found on the piles above water. Fourteen piles are recommended for repair with surface applied epoxy mortar as part of future maintenance.

It is also recommended for new construction that all lifting loops be removed at the time of installation. An underwater inspection of all new construction is recommended to confirm compliance with the design details.

The pier and dolphin should be reinspected at intervals not to exceed six years.

EXECUTIVE SUMMARY

The underwater inspection of the Floating Dry Dock Mooring Facility (ARDM) at the Naval Submarine Base at Kings Bay, Georgia, performed in June, 1985, indicated that the facility is generally in excellent condition.

Both the pier and the spud dolphin are in excellent condition below water. No underwater repairs are warranted at this time. There are, however, exposed and corroded steel wire lifting loops on the piles below water that could provide an area where future deterioration of the piles could begin. It is planned to remove some of the piles at the ARDM facility in the near future as part of planned improvements. It is recommended that those piles be inspected internally to determine if the corrosion extends into the piles, and to determine if removal of the loops and patching is necessary to maintain the structures.

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The pier and dolphin should be reinspected at intervals not to exceed six years.

The table on the following page summarizes the condition of the pier and dolphin, and the recommended repairs with associated costs.

UNDERWATER FACILITIES INSPECTION AND ASSESSMENT

AT

FLOATING DRY DOCK MOORING FACILITY (ARDM)

NAVAL SUBMARINE BASE

KINGS BAY, GEORGIA

Facility	Year Built/ Reconstructed	No. of Vertical Piles	No. of Batter Piles	Facility Size Length by Width	Structure Type	Recommendations*	Estimated Cost of Recommendations
ARDM							
Pier	1979	270	124	1,014 ft x 28 ft 80 ft x 15 ft 190 ft x 60 ft 170 ft x 30 ft 170 ft x 60 ft 70 ft x 55 ft	18 in. square & 24 in square prestressed concrete piles	Repair surface of 6 piles with epoxy grout.....	$5,000
Spud Dolphin	1979	60	103	270 ft x 40 ft	24 in. square prestressed concrete piles	Repair surface of 8 piles with epoxy grout.....	$5,000

* Conduct investigation of corrosion of lifting loops.
Reinspect facilities at 6 year intervals.

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UNDERWATER FACILITIES

INSPECTION AND ASSESSMENT

AT THE

NAVAL SUBMARINE BASE

KINGS BAY, GEORGIA

1. INTRODUCTION

This report consists of the results of a detailed underwater inspection and assessment of submerged portions of piles of the Floating Dry Dock Mooring Facility (ARDM) at the Naval Submarine Base at Kings Bay, Georgia.

The investigation was conducted by Collins Engineers, Inc. for the Ocean Engineering and Construction Project Office (FPO-1) of the Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) as Task No. 1 of Contract N62477-85-D-0084 as part of NAVFAC's Specialized Inspection Program. The Specialized Inspection Program sponsors task-oriented engineering services for the inspection, analysis, design and monitoring of repairs for the submerged portions of selected Naval waterfront facilities.

1.1 Task Description

This task consisted of furnishing the engineering services necessary to achieve an assessment of the apparent general condition of the piles supporting the pier and spud dolphin of the ARDM. This task consisted of two parts: a field inspection portion and an assessment portion.

The field inspection portion of the investigation consisted of an underwater inspection of submerged pilings by two engineer-divers and a technician-diver, and an above water inspection of the members near the waterline. The inspection was conducted in such detail as to permit a general assessment of the physical condition of the portions of the substructure that are submerged or subject to frequent wetting by wave or tidal action. A visual "swim-by" survey was made of all facilities under investigation, and a more detailed visual and tactile inspection was made of selected facility components. This detailed inspection included scraping and cleaning.

A total inspection included three levels of examination, employed as phases. Each facility/structural element was inspected in one, two, or three of these phases (Levels I, II, and III) as considered necessary for adequate condition assessments and are delineated in Paragraph 3.1. These inspection phases, or levels of examination, were performed in accordance with the CHESNAVFACENGCOM scope of work definitions indicated below:

Inspection Phase Level I:	General: This inspection phase is essentially a "swim-by" overview, which does not involve cleaning of any structural elements, and therefore can be conducted much more rapidly than the other levels of examination. The Level I examination should confirm as-built structural plans and detect obvious major damage or deterioration due to overstress (collisions, ice), severe corrosion, or extensive biological attack. The underwater inspector shall generally rely primarily on visual and tactile observations to make condition assessments. Visual documentation (utilizing underwater television and/or photography) may be included with the quantity and quality adequate for documentation of the findings which will be representative of the facility condition.
Inspection Phase Level II:	Detailed: This phase of the inspection will often require prior cleaning of the structural elements. The purpose of the Level II examination is to detect surface damage which may be hidden by marine growth and/or deteriorated surface material. Generally, cleaning is time-consuming, and therefore restricted to areas that are critical or which may be representative of the entire structure itself. The amount and thoroughness of cleaning to be performed is governed by what is necessary to discern the exterior physical condition of the structural members, and to rapidly obtain nominal measurements by means of simple instruments such as calipers, measuring tapes, and ice picks. This inspection phase should identify areas that have been mechanically damaged or are in advanced states of deterioration. Visual documentation (utilizing underwater television and/or photography) and a sampling of physical measurements should be included with the quantity and quality adequate for documentation of the findings which will be representative of the facility condition.
Inspection Phase Level III:	Highly Detailed: This inspection phase will often require the use of Non-Destructive Testing (NDT) techniques. It may also require the use of partially destructive techniques such as sample coring through wood structures, physical material sampling, or in-situ surface hardness testing. This phase will usually require prior cleaning of the structure. The

use of NDT techniques generally concentrates on key structural areas, suspect areas, and structural members most representative of the underwater structure. Underwater television and/or photography showing examples of the facility's condition may be included.

The assessment portion of the investigation consisted of documenting the configuration of the existing structures; summarizing the conditions encountered during the field inspection; evaluating their structural and functional significance; and recommending actions that should be taken to insure long-term, cost-effective maintenance and utilization of the facilities. Estimated costs for repairs were also developed.

1.2 Report Content

The report contains a description of the Naval Submarine Base and its facilities including location; mission; and environmental data describing climatic, topographic, and geologic features along with a discussion of the inspection procedures. The report also contains the results of the inspection and an assessment of the findings, accompanied by pertinent drawings and photographs. The inspection results include a description of the structural configuration of the facilities along with their apparent condition and an assessment of the conditions found. Recommendations including cost estimates for any repair or maintenance work are also included.

1.3 Points of Contact

Management of this contract by the Ocean Engineering and Construction Project Office (FPO-1) of the Chesapeake Division, Naval Facilities Engineering Command was provided by Mr. Philip T. Scola, Program Manager, and Mr. Wade F. Casey, Project Engineer in Charge. Points of contact at the Public Works Department of the Naval Submarine Base were Commander A. W. Johnson, Public Works Officer, and Mr. J. Allen, Supervisory Civil Engineer, Planning Branch.

1.4 Exit Briefing

An exit briefing was provided for base personnel on 31 May 85. Pertinent findings from the inspection were presented and discussed. The following persons were in attendance:

NSB Personnel (Telephone 912/673-4816)

Cmdr. A. W. Johnson	P.W.O.	
Mr. J. Allen	P.W.	N521
Mr. F. L. Todd	P.W.	N521F
Mr. R. L. Ripley	OICC Trident	0421A
Mr. S. Zavoyski	Trident	0424A
Mr. D. Lovett	P.W.	N52

CHESDIV NAVFAC Personnel (Telephone 202/433-3881)

Mr. Wade F. Casey	FPO-1

Collins Engineers, Inc. (Telephone 312/454-1060)

Mr. Thomas J. Collins

2. ACTIVITY DESCRIPTION

2.1 Name of Activity

Naval Submarine Base, Kings Bay Georgia.

2.2 Location of Activity

"The Kings Bay Naval Submarine Base (NSB) is located in the southeast corner of Georgia approximately eight miles north of the Georgia-Florida border. The closest settlement to the facility is a small Georgia town called St. Mary's which borders on the southern boundary of the site. The Base derives its name from an adjacent water body, Kings Bay, which empties into Cumberland Sound and eventually into the Atlantic Ocean. This bay provides the port for the submarine refit operations." (Note 1)

"The Naval Submarine Base contains 16,168 acres of land. The site was originally an 8,823 acre U.S. Army facility, used as a contingency base for transshipment of explosives. In 1978, the Navy acquired the Kings Bay Military Ocean Terminal (MOTKI)...The Navy has purchased an additional 3,329 acres surrounding MOTKI. The remaining 4.016 acres is held under restrictive easements." (Note 2)

Refer to Figures 1, 2, and 3.

2.3 Mission of Activity

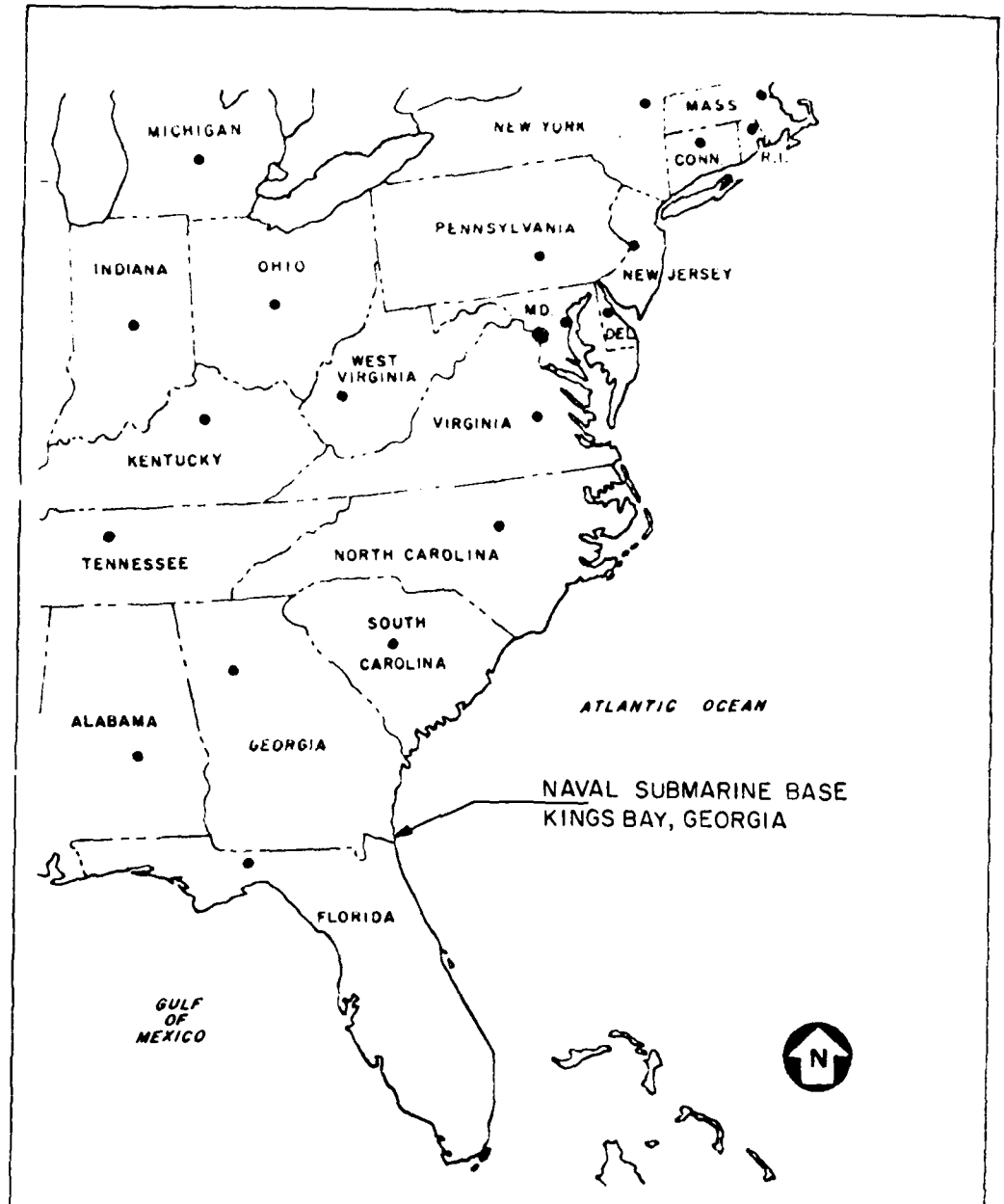
The Navy has designated Kings Bay, Georgia as a Trident support site and is expected to provide facilities for 10 Nuclear-Powered Fleet Ballistic Missile Submarines (SSBNs).

"The primary functions of the Naval Submarine Base include:

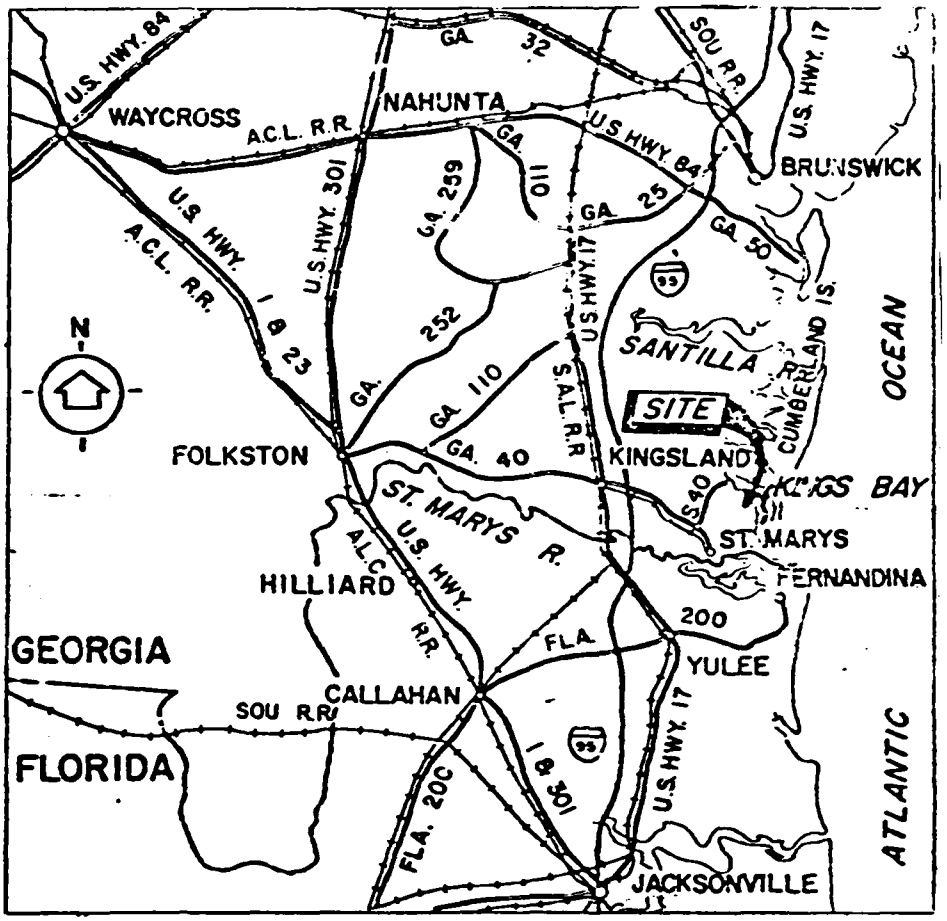
* Ship refit: This function will perform resupply, refit and repair operations. The refit facilities will include shops, storage and staging, and a management center. A Dry Dock and two Refit Wharves will be located at the waterfront.

* Missile Support: This function, the Strategic Weapons Facility (SWF), will include Explosive Handling Wharves, storage facilities for the missiles, and missile production and assembly facilities.

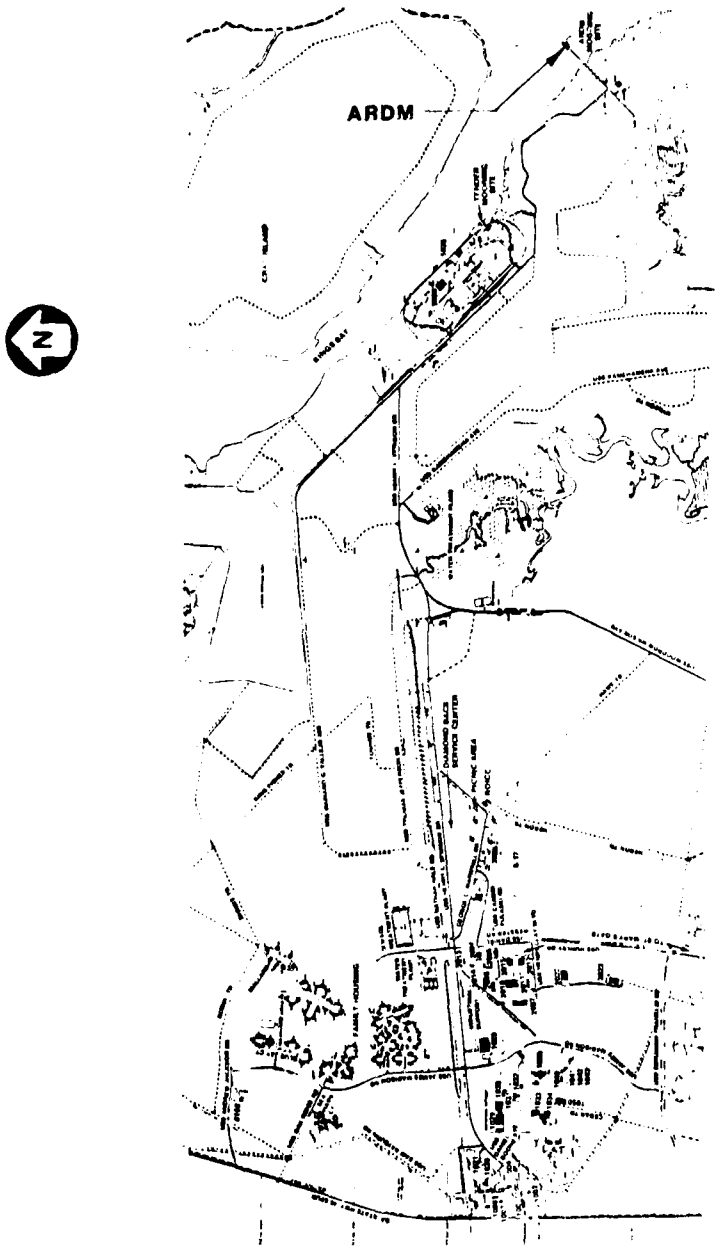
* Poseidon Squadron Support Site: This function provides the industrial, personnel and refit facilities necessary



COLLINS ENGINEERS, INC. 600 W. JACKSON CHICAGO, ILLINOIS	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C. NAVAL SUBMARINE BASE KINGS BAY, GEORGIA LOCATION MAP CONTRACT NO. N62477-80-D-0004	FIG NO. 2.1-1



COLLINS ENGINEERS, INC. 600 W. JACKSON CHICAGO, ILLINOIS	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C. NAVAL SUBMARINE BASE KINGS BAY, GEORGIA AREA MAP CONTRACT NO. N62477-88-D-0084	FIG NO. 2.2-2



COLLINS ENGINEERS, INC. 600 W. JACKSON CHICAGO, ILLINOIS	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	
	NAVAL SUBMARINE BASE KINGS BAY, GEORGIA	FIG NO.
	LOCATION PLAN CONTRACT NO. N62477-80-C-0084	2.2-3

to maintain the 10 boat Poseidon squadron (T-1).... The Waterfront operations include facilities for mooring both the Tender and the floating dry dock (ARDM), the extended refit program, the rehabilitated Blue Star Shipping Warehouse, and the Harbor Master building. Additional support facilities...include public works, industrial refit, community and personnel support, family housing, and security facilities....

* Base Support: This function will provide the necessary physical security, administration, public works, housing, and other community and personnel support services and facilities required to maintain the site....

"Facilities at Kings Bay are being planned and developed to provide for growth capabilities as follows:

* Tender support facilities for one squadron of Poseidon SSBNs....

* Ashore support facilities for one squadron of Trident SSBNs....

* Ashore support facilities for a second squadron of Trident SSBNs ... and/or a Tender support facility for a second squadron of Poseidon SSBNs....

"Tender support facilities for one squadron either currently exist or are under construction at the Base."(Note 3)

2.4 Description of Activity

This report is concerned with the ARDM facilities located at the Kings Bay Naval Submarine Base. For this report, the two structurally independent facilities, the pier and mooring dolphin are considered separately. The table below identifies the principal features of the facilities which are the subject of this report:

Facility	Year Built	Approximate Dimensions
Pier :		
Access Trestle	1979	1,014 ft x 20 ft
Turnaround Area	1979	190 ft x 60 ft
Outboard Finger Pier	1979	169 ft x 30 ft
Inboard Finger Pier	1979	169 ft x 60 ft
Electrical Substation Area	1979	70 ft x 55 ft
Spud Dolphin	1979	270 ft x 40 ft

The Base Master Plan, Naval Submarine Base, Kings Bay, Georgia, Volume II, The Master Plan, January, 1981 indicates that a "tender, with four submarines and support facilities, will be moved to the present mooring site of the dry dock (ARDM). Prior to this move a new facility to accommodate the ARDM will be constructed south of its present location...."(Note 4)

2.5 Environmental Data

2.5.1 Climate

"The region has a subtropical marine climate with hot, wet summers and cool, dry winters.... The mean annual temperature is approximately 68 degrees F although it rarely goes above 100 degrees F because of the moderating effect of the ocean. Mean annual precipitation is 54 inches, which occurs predominantly during the summer as showers and thunderstorms. Prevailing winds are from the west. Tropical cyclones and hurricanes are rare but have occurred in the past, usually during the late summer."(Note 5)

2.5.2 Topography

"Extensive marshlands and numerous coastal waterways are the predominant features of the area's landscape. The major landform evident...is Cumberland Island which is an 18 mile-long barrier island bordering the Atlantic Ocean. Several large rivers traverse the county from west to east, emptying into the bays and sounds west of Cumberland Island....

"The highest point in the region is about 60 feet above mean sea level (msl), and the average elevation is approximately 30 feet above msl. The topography slopes gradually eastward from the higher inland elevations, although the slope is so gradual that it is usually not evident. The soils are saturated by a high water table throughout most of the region with forests growing in the upland swamps. Salt marshes border estuarine waters and tidal rivers and provide an invaluable nutrient source for the coastal ecosystem...."(Note 6)

"Topographic elevations within the Base range from 0 mean sea level (msl), along Kings Bay and Cumberland Sound to approximately 30 feet above msl at the western boundary of the property. Significant slopes exist only along the stream banks or eastern shoreline which is a previous barrier island formation. Otherwise, the Base is virtually flat with no outstanding natural landforms. Man-made landforms are predominant because of the site's characteristic flatness." (Note 7)

"Tides fluctuate with a mean annual range of 5.8 feet at the Southern end of Cumberland Island" (Note 8)

2.5.3 Geology and Soils

"The geologic history of the Base is representative of the region's geologic development. The surficial material is a result of deposits made during the Pleistocene epoch when former shorelines existed further inland than the present shoreline. Remnants of the Pamlico shoreline are evident at the western edge of the Base, and the Princess Ann shoreline is prevalent throughout the eastern portion of the Base.... These deposits have been, and continue to be, modified by wind and water erosion.

"The surficial deposits vary in depth from 40 to 100 feet. The depth of this material in the waterfront area has an effect on dredging and excavation in that area. Stratified limestone layers lie beneath the depositional material and are considerably more difficult and expensive to remove than the softer surficial deposits."(Note 9)

"Soils on Base represent constraints to development because of their poor drainage characteristics. Of the eight soil types on Base, only two have a depth to the seasonal high water table greater than 1.5 feet...much of the site is covered by poorly drained soils.

"All the soils on Base are derived from marine sediments. They consist generally of sands on the upland areas and clays in the tidal wetland areas."(Note 10)

The ARDM facilities are located in an area of Bohicket-Capers Association soil type, where the water table is near the surface during part of the year and the permeability characteristics are slow.

2.5.4 Seismic Activity

The Naval Station is located in Seismic Probability Zone 1, where major damage would be slight. "The depth to bedrock is approximately 4000 feet below the surface. This bedrock material has historically been seismically stable, and there are no known faults within the Base's Boundaries which could initiate seismic action."(Note 11)

2.6 Footnotes

1. Base Master Plan, Naval Submarine Base, Kings Bay, Georgia, Officer in Charge of Construction-Trident, January, 1981, Vol. I, p. 3.
2. Ibid., Vol. I, p. 25.
3. Ibid., Vol. II, p. 7.
4. Ibid., Vol. II, p. 35.
5. Ibid., Vol. I, p. 6.
6. Ibid.
7. Ibid., Vol. I, p. 32.
8. Ibid., Vol. I, p. 8.
9. Ibid., Vol. I, p. 28.
10. Ibid., Vol. I, p. 32.
11. Ibid., Vol. I, p. 28.

Representative as well as unusual conditions observed during the various levels of examination were documented with color photographs.

3.2 Inspection Procedure

A detailed underwater inspection was made of the accessible portions of the facilities described above. The inspection included concrete bearing and batter piles from the pile cap to the ML.

The underwater inspection was conducted by a three person team, consisting of two engineer-divers, and one technician-diver. The divers, using scuba equipment, worked from a small boat, or from the facility itself.

In making the inspections, two divers were in the water near each other. A tender/notetaker observed and coordinated the divers' work. The Level I examination performed on concrete piles generally consisted of the diver descending individual piles, circling around the piles while examining them. Upon reaching the bottom, the diver swam to the next pile and continued the inspection. When the distance between piles was so great that the diver could not swim to an adjacent pile because of low visibility, or where the close spacing of the piles prevented circling the piles, the diver descended on one side of a pile and surfaced on another side of the same pile.

Selected elements of the facilities were given a more detailed visual and tactile examination (Level II). The detailed examination performed on the concrete piles included cleaning and scraping, and sounding and probing as necessary to determine the condition of the pile. When defective areas were discovered, the piles were cleaned over larger areas in order to determine the extent of the distress.

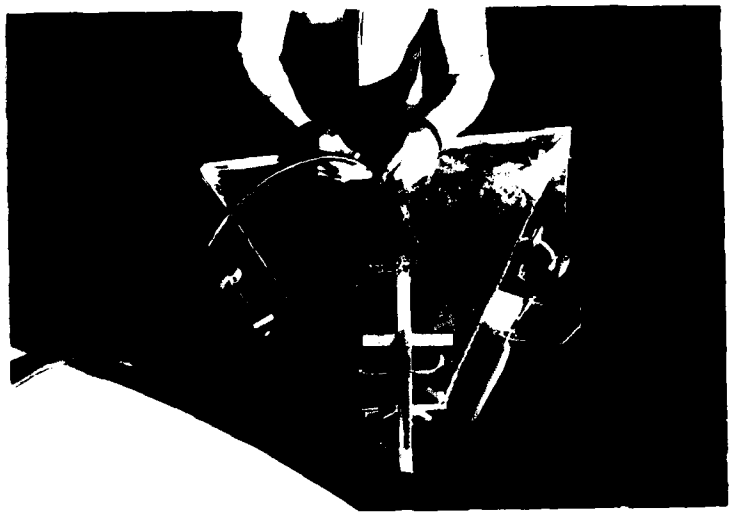
The divers scraped and cleaned representative areas to include Level II examination during the Level I examination. Photography was completed at a later time. The inspection team also used a lead line to determine channel bottom elevations adjacent to the ARDM facilities.

Underwater photography, detailed notes and sketches were used to document the conditions encountered in the inspection. Also, an on-site report of the progress of the inspection was made on a daily basis to the on-site government representative.

3.3 Inspection Equipment

During the inspection, various pieces of equipment were used to accomplish different tasks. Scrapers and hammers were used to clean the piles. Miscellaneous minor equipment included dive lights, knives, sounding lines, and spray paint.

A clear water box, a Nikonos IV-A underwater camera with various lenses and two Popular Aqua Fl strobes were used to document the inspection findings. Refer to Photograph 3.3-1 for a view of the clear water box with the camera and strobes attached.



PHOTOGRAPH 3.3-1
Clearwater Box.

4. FACILITIES INSPECTED

The facilities inspected at the ARDM at Kings Bay Naval Submarine Base are discussed in the following sections. The discussion of each group of facilities is presented in four parts:

1. A description of the facilities,
2. A discussion of the conditions observed during the inspection,
3. An assessment of the conditions,
4. Recommendations to ensure long term serviceability.

In the sections which describe the configuration of each part of the facilities, the figures included were developed from available drawings and inspection notes. Available design load data is summarized for the structures. These figures may be found on the pages immediately following the descriptive section. Their general conformance with actual field conditions was verified by visual observations and measurement.

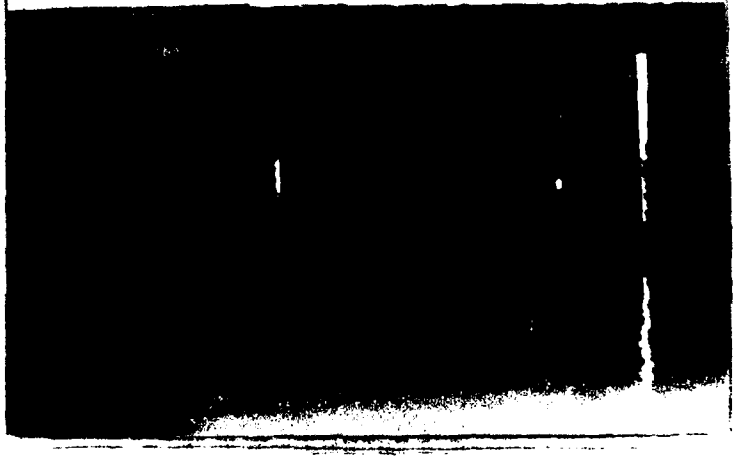
The underwater visibility at the time of the inspection generally ranged from one to three feet. Dredging operations and tug operations adjacent to the ARDM greatly reduced visibility. All water depths described in the following sections are referred to Mean Low Water, Elevation 0.00.

Detailed breakdowns of the cost estimates for recommended repair and maintenance are included in the Appendix.

The marine growth on the structures generally consisted of three to six inches of tightly attached oysters and other mollusks, barnacles, and stringy fibrous plants up to about one foot in length. The oysters were most dense in the tidal zone. Six feet below mean low water the growth generally consisted of softer marine plants. All types of marine growth extended downward for about thirty to forty feet, where the depth was that great. Below forty feet, the growth generally thinned out to a thickness of less than one inch. All of the marine growth could be removed by vigorous hand scraping, although the oysters were very tightly attached. The concrete piles have been stained brown by the bay water. Refer to Photograph 4.-1 through 4.-4 for typical examples of the marine growth present on the ARDM facilities.

PHOTOGRAPH 4.-1
Typical Marine Growth in Tidal Zone, Access Trestle, ARDM.

PHOTOGRAPH 4.-2
Typical Marine Growth in Tidal Zone, Bent 1, Spud Dolphin.



PHOTOGRAPH 4.-3
Typical Marine Growth, Pile 28A, Elevation -5, Pier.

PHOTOGRAPH 4.-4
Typical Marine Growth, Pile 42X, Elevation -10, Floating Dock.

4.1 ARDM Pier

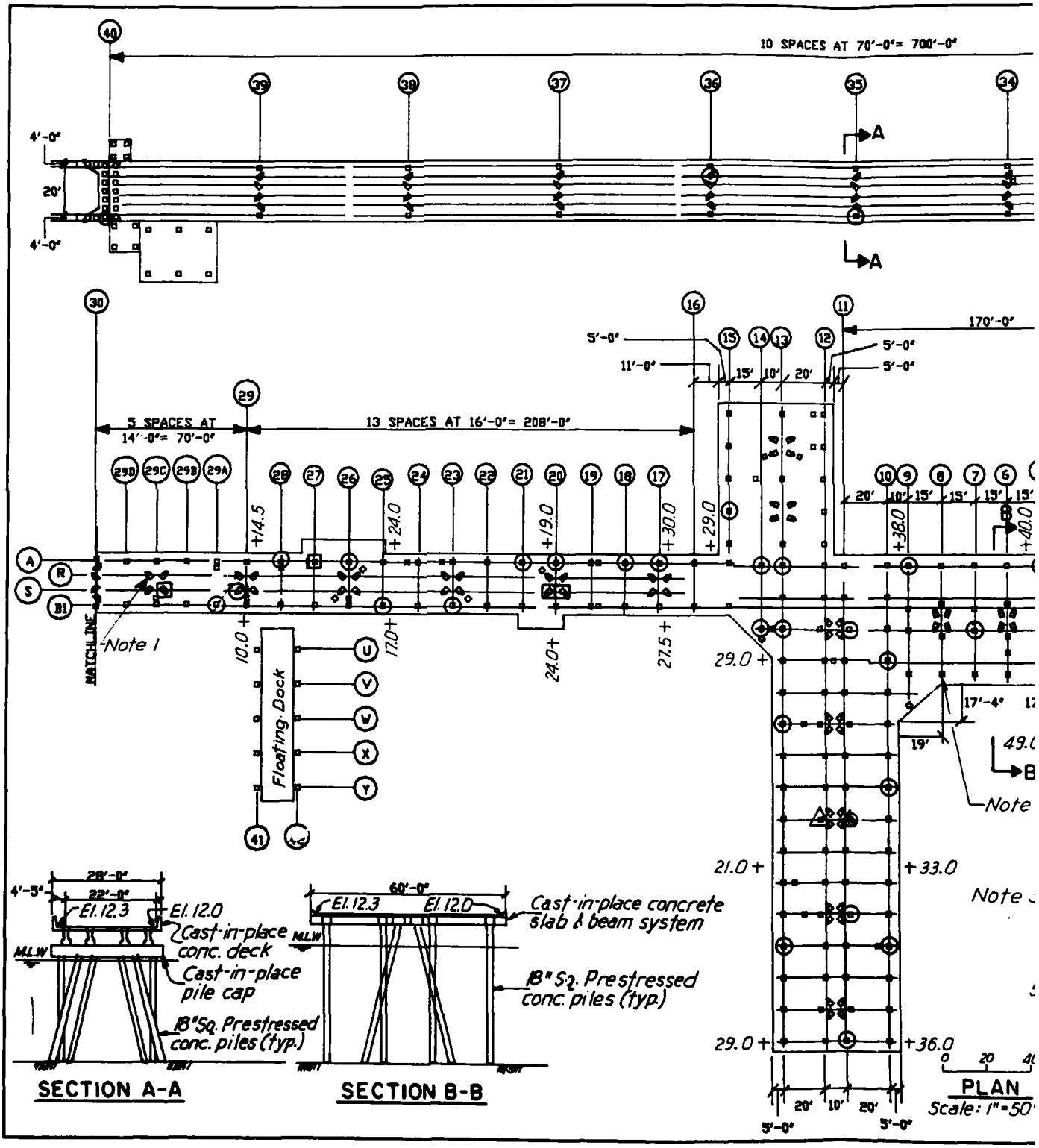
4.1.1 Description

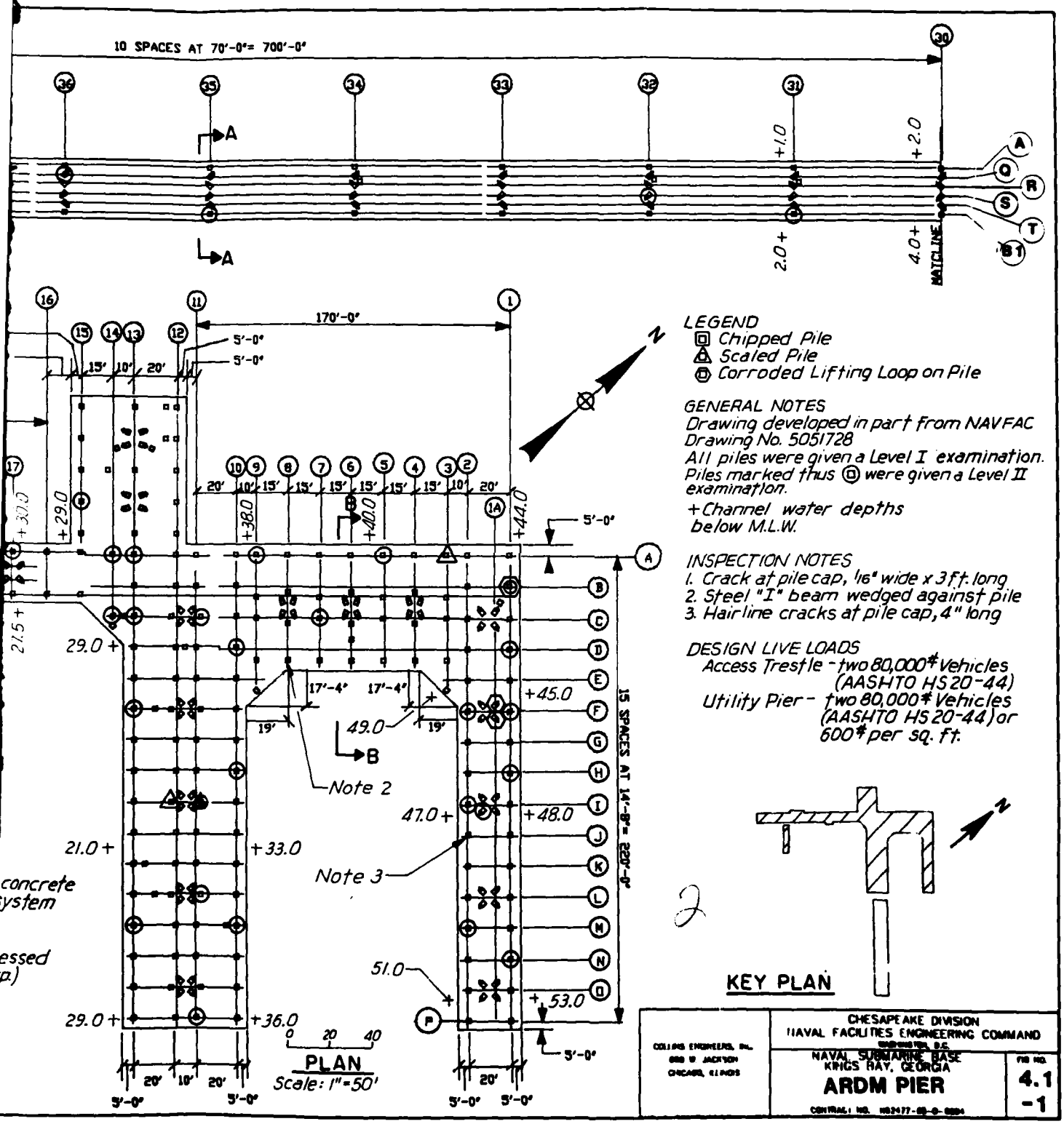
The Floating Dry Dock Mooring Facility (ARDM) was constructed in Kings Bay near its mouth at Cumberland Sound in 1979. The pier portion of the facility consists of an access trestle, electrical substation area, utility pier, and floating dock. Refer to Figure 4.1-1 for a plan and typical sections showing the configuration of the structures and Photographs 4.1-1 through 4.1-4 for overall views of the pier structures.

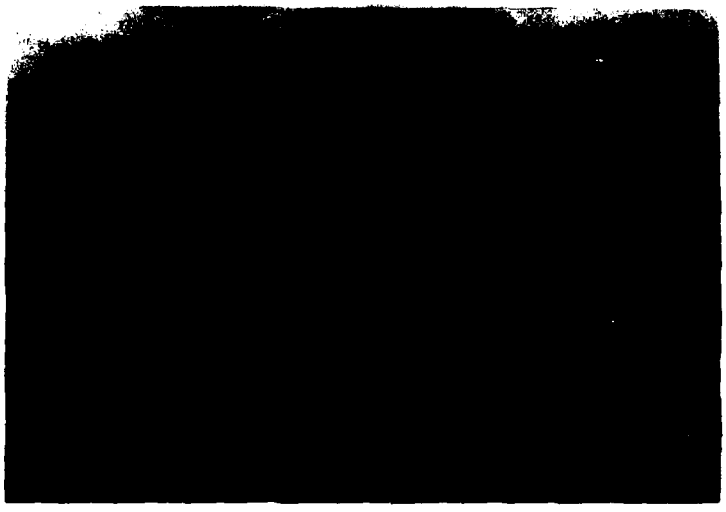
The access trestle is a concrete structure approximately 1,014 feet long by 28 feet wide, extending from the shore to the turnaround area. At shore, a 10 feet by 10 feet gate house structure, a 14 feet by 14 feet pump station structure, and a 30 feet by 30 feet oil separator structure are located adjacent to and contiguous with the access trestle. The access trestle and ancillary structures described in this paragraph are constructed of 103 vertical and 64 batter precast, prestressed, 18-inch square, concrete piles. Between Bents 30 and 40, at the inboard end of the trestle, cast-in-place concrete pile caps support precast, prestressed concrete beams with a cast-in-place concrete deck slab. For the remainder of the trestle, a cast-in-place concrete slab and beam system is supported directly on the piles. The access trestle is designed for live load due to passing of two fully loaded tractor trailers of 80,000 pounds maximum gross weight each (AASHTO HS20-44 loading). The water depth varies along the access trestle from zero at the shoreline to about 30 feet near the outboard end. Refer to Photograph 4.1-1 for a view of the access trestle.

A floating dock, 80 feet long by 15 feet wide, connected to the access trestle by a brow, is located along the southeasterly side of the trestle midway between shore and the outboard end of the trestle. The floating dock is restrained by 10 vertical, 18-inch square precast, prestressed concrete piles which guide it as it rises and lowers with tidal variations. The water near the floating dock is generally about 20 feet deep. Refer to Photograph 4.1-2 for a view of the floating dock.

The utility pier is located at the outboard end of the access trestle. It consists of a turnaround area and two finger piers which extend along the sides of the floating dry dock. At the time of the inspection, the floating drydock was not moored at the ARDM facilities. The turnaround area is generally 190 feet long by 60 feet wide. The outboard finger pier is approximately 170 feet long by 30 feet wide, and the inboard finger pier is approximately 170 feet long by 60 feet wide. The utility pier is constructed of 140 vertical and 52 batter precast, prestressed, 24-inch square concrete piles with a cast-in-place concrete slab and beam system atop the piles. The utility pier is designed for live load due to the passing of two fully loaded tractor trailers of 80,000 pounds maximum gross weight each or 600 pounds per square foot distributed loading. The water depth around the


10 SPACES AT 70'-0"= 700'-0"
4'-0"
20'
4'-0"
A
A
170'-0"
5'-0"
11'-0"
15'
10'
20'
5'-0"
5'-0"
5 SPACES AT
14'-0"= 70'-0"
13 SPACES AT 16'-0"= 208'-0"
+14.5
+24.0
+19.0
+30.0
+29.0
+38.0
+40.0
20'
10'
15'
15'
15'
15'
Note 1
MATCH LINE
10.0 +
17.0+
24.0+
27.5 +
29.0 +
Floating Dock
17'-4"
19'
Note
49.0
B
21.0 +
+33.0
Note
29.0 +
+36.0
0 20 40
PLAN
Scale: 1"=50'
20'
10'
20'
5'-0"
5'-0"
28'-0"
22'-0"
4'-3"
El. 12.3
El. 12.0
Cast-in-place conc. deck
Cast-in-place pile cap
18"Sq. Prestressed conc. piles (typ.)
M.L.W.
SECTION A-A
60'-0"
El. 12.3
El. 12.0
Cast-in-place concrete slab & beam system
18" Sq. Prestressed conc. piles (typ.)
M.L.W.
SECTION B-B


10 SPACES AT 70'-0"= 700'-0"
170'-0"
5'-0"
5'-0"
15' 10' 20'
20' 10' 15' 15' 15' 15' 15' 15' 10' 20'
+29.0
+30.0
+38.0
+40.0
+44.0
5'-0"
+45.0
49.0
17'-4"
17'-4"
19'
19'
Note 2
47.0+
+48.0
21.0+
+33.0
Note 3
51.0
29.0+
+36.0
+53.0
5'-0"
15 SPACES AT 14'-8"= 220'-0"
0 20 40
PLAN
Scale: 1"=50'
20' 10' 20'
5'-0" 5'-0"
20'
5'-0" 5'-0"
+1.0
+2.0
2.0+
4.0+
MATCHLINE
A
Q
R
S
T
B1
A
A
B
B
N
LEGEND
Chipped Pile
Scaled Pile
Corroded Lifting Loop on Pile
GENERAL NOTES
Drawing developed in part from NAVFAC Drawing No. 5051728
All piles were given a Level I examination.
Piles marked thus ◎ were given a Level II examination.
+Channel water depths below M.L.W.
INSPECTION NOTES
1. Crack at pile cap, 1/16" wide x 3 ft. long
2. Steel "I" beam wedged against pile
3. Hairline cracks at pile cap, 4" long
DESIGN LIVE LOADS
Access Trestle - two 80,000# Vehicles (AASHTO HS 20-44)
Utility Pier - two 80,000# Vehicles (AASHTO HS 20-44) or 600# per sq. ft.
KEY PLAN
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA
ARDM PIER
4.1
-1

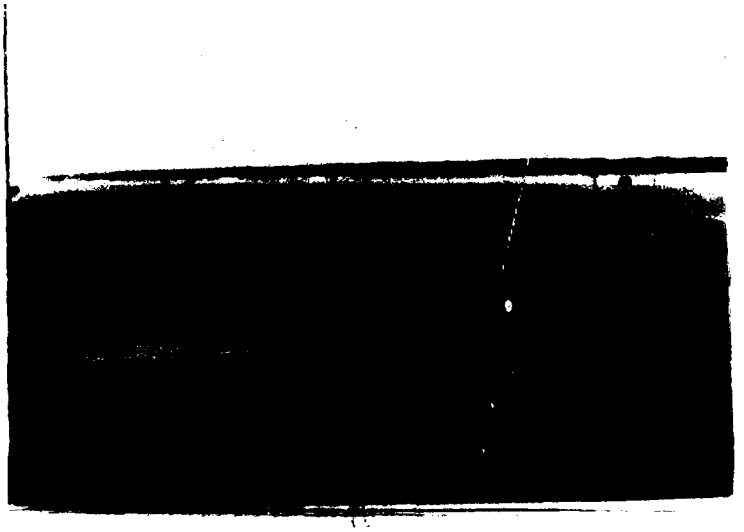


PHOTOGRAPH 4.1-1
Pier Access Trestle, Looking West.

PHOTOGRAPH 4.1-2
Pier Floating Dock, Looking Northwest.

PHOTOGRAPH 4.1-3
Pier Electrical Transformer Area and
Turnaround Area, Looking North.

PHOTOGRAPH 4.1-4
Pier Finger Piers, Looking Northwest.



facility varies from about 30 feet at its most inboard area to about 53 feet at the outboard end. Refer to Photographs 4.1-3 and 4.1-4 for views of the turnaround area and finger piers, respectively.

An electrical transformer platform is located along the northwesterly side of the utility pier near its juncture with the access trestle. The deck of this 70 feet by 55 feet structure was fenced off during the inspection, but it is virtually a continuation of the utility pier. It is constructed of 17 vertical and 8 batter 24-inch square, precast, prestressed concrete piles with a cast-in-place concrete slab and beam system atop the piles. The water depth around the transformer platform is generally about 35 feet deep. Refer to Photograph 4.1-3 for a view of the transformer area.

4.1.2 Observed Inspection Condition

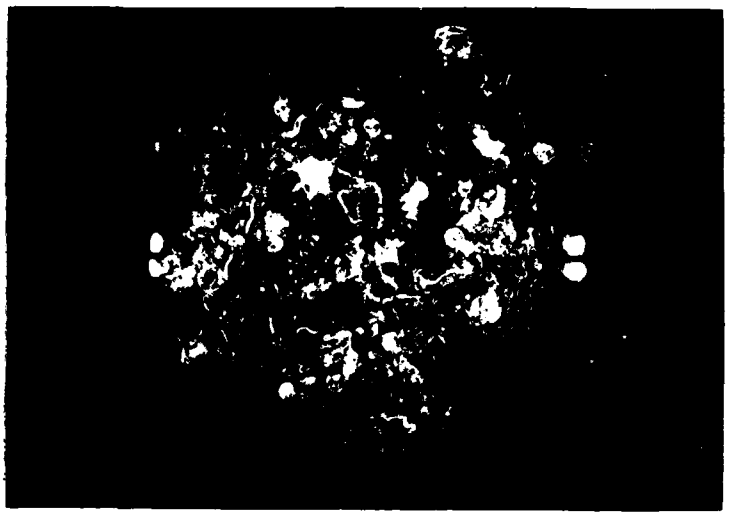
The prestressed concrete piles of the access trestle, utility pier, transformer platform and floating dock are in excellent condition below water. The only evidence of distress below water was found on Pile 13A which had a slightly abraded area on one corner approximately three feet long. During the Level II cleaning of the piles, wire rope lifting loops were found on three piles. These loops are corroding, and strands of some of the loops have broken due to corrosion. One loop on Pile 1B, as shown in Photograph 4.1-5, appears to have been cut off near the face of the pile. The location of the lifting loops appeared to be random, depending in part on the depth to which the piles were driven. The elevation of the loops of two adjacent piles, for example, varied by about seven feet. Photographs 4.1-6 through 4.1-15 illustrate the typical condition of the piles underwater.

Above water, the piles were also generally found to be in excellent condition. There were, however, a few minor areas of cracking of the piles near the underside of the deck as shown in Photographs 4.1-16 and 4.1-17. These areas of distress are generally very minor and randomly located. Six piles, 29C-S outboard, 29C-R inboard, 27A, 20S inboard, 20S outboard, and 12I have minor, but measurable areas of cracking and scaling. Refer to Page A-1 in the Appendix for a summary of the defects found during the inspection.

It was also noted that there has been minor damage to the deck system from vessels at three locations. On the southeasterly side of the access trestle at Bent 20, there is some minor cracking near the joint between the deck slab and curb as shown in Photographs 4.1-18 and 4.1-19. Minor cracking and abrasion of the concrete deck was also found at the outboard ends of the finger piers as shown in Photographs 4.1-20 and 4.1-21. No evidence of damage below water was found in areas adjacent to the deck damage.

PHOTOGRAPH 4.1-5
Pier Pile 1B, Elevation -5, Typical Pile Condition.

PHOTOGRAPH 4.1-6
Pier Pile 29C-S Inboard, Elevation -5, Typical Pile Condition.

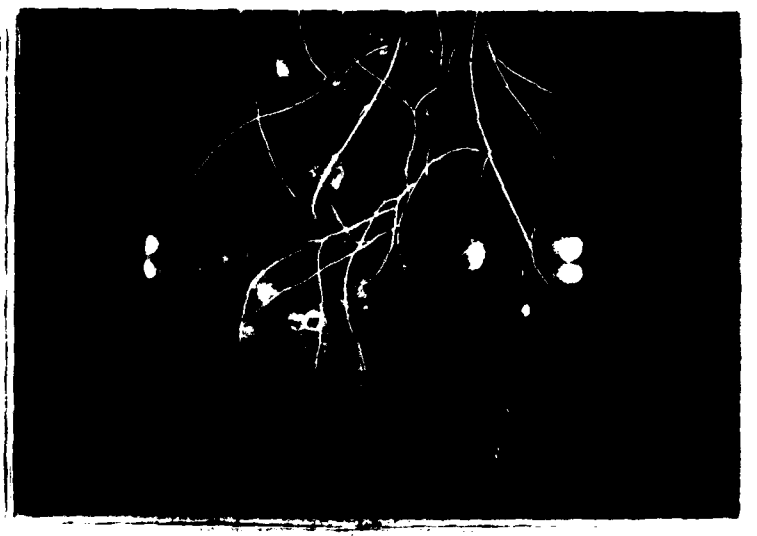


PHOTOGRAPH 4.1-7
Pier Pile 29C-S Inboard, Elevation -12, Typical Pile Condition.

PHOTOGRAPH 4.1-8
Pier Pile 29B1, Elevation -10, Typical Pile Condition.

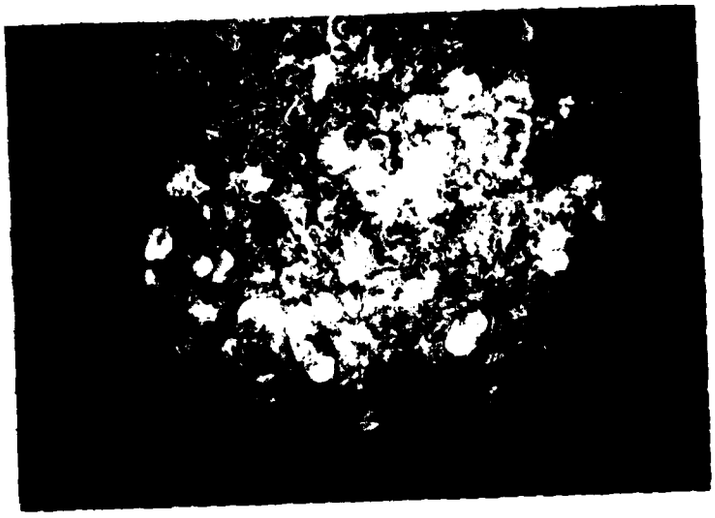
PHOTOGRAPH 4.1-9
Pier Pile 30A, Elevation -5, Typical
Pile Condition.

PHOTOGRAPH 4.1-10
Pier Pile 42X, Elevation -20, Typical
Pile Condition.



PHOTOGRAPH 4.1-11
Pier Pile 42Y, Elevation -5, Typical
Pile Condition.

PHOTOGRAPH 4.1-12
Pier Pile 28C, Elevation -2, Typical
Pile Condition.



PHOTOGRAPH 4.1-13
Pier Pile 26B1, Elevation -15, Typical
Pile Condition.

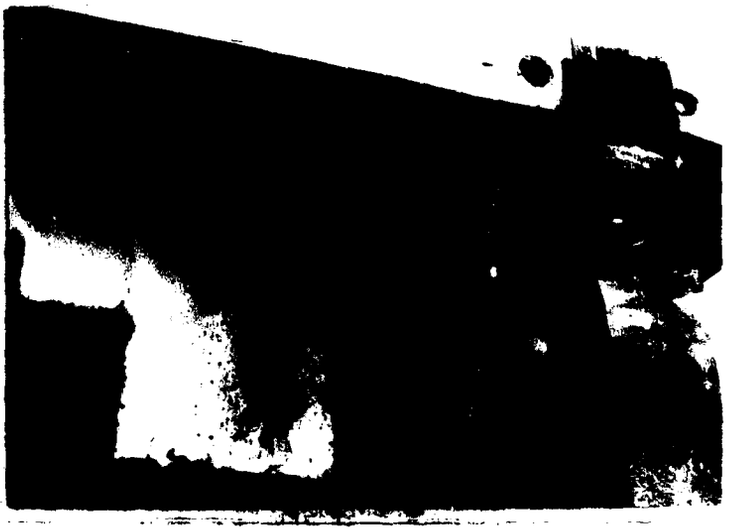
PHOTOGRAPH 4.1-14
Pier Pile 26B1, Elevation -25, Typical
Pile Condition.

PHOTOGRAPH 4.1-15
Pier Pile 26B1, Elevation -5, Typical
Pile Condition.

PHOTOGRAPH 4.1-16
Pier Pile 2J.

PHOTOGRAPH 4.1-17
Pier Pile 1aL, Looking East.

PHOTOGRAPH 4.1-18
Pier Trestle Deck at Bent 20, Looking North.



PHOTOGRAPH 4.1-19
Pier Access Trestle Deck at Bent 20,
Looking West.

PHOTOGRAPH 4.1-20
Pier Inboard Finger Pier Deck near Pile 13P,
Looking North.

PHOTOGRAPH 4.1-21
Pier Outboard Finger Pier Deck near
Pile 1P, Looking North.

4.1.3 Structural Condition Assessment

The prestressed concrete piles of the ARDM pier, including the access trestle, utility pier, transformer platform and floating dock are generally in excellent condition at this time. There is no damage or deterioration below water which warrants repair at this time. The cracked and chipped areas that were found above water are generally very minor, but the areas of cracking and scaling noted on Piles 29C-S outboard, 29C-R inboard, 27A, 20S inboard, 20S outboard, and 12I should be repaired as a part of future maintenance operations to prevent further deterioration. The other areas of deterioration noted during the inspection are so minor that no accelerated future deterioration is anticipated as a result of them.

The corroded lifting loops that were found on some of the piles are not in themselves structurally significant, but they provide a path through which oxygen and moisture may enter the pile and establish an environment in which corrosion of the pile could eventually occur. It can be anticipated, from the number of lifting loops found during this inspection, that there may be lifting loops hidden beneath the marine growth on most of the piles. Their location, as to which side of the pile and at which depth, appears to be random. Severe corrosion is occurring to these lifting loops - probably due in part to the oxygen that is entrapped by the churning wash of tugs operating in the area.

Because the products of corrosion can occupy over ten times the volume of the original base metal and can develop pressures in the concrete in excess of 5,000 pounds per square inch, the corroding lifting loop, and corrosion of any mild steel reinforcement that may be in contact with the loop, could crack the pile and break off pieces of the concrete exposing the interior of the members to additional damage and deterioration.

4.1.4 Recommendations

It is recommended that the areas of scaling and minor cracking on Piles 29C-S outboard, 29C-R inboard, 27A, 20S inboard, 20S outboard, and 12I be repaired by patching with surface applied epoxy mortar. Prior to applying the mortar, any loose concrete should be removed and any exposed reinforcing steel should be cleaned. The estimated cost of these repairs is approximately $5,000. Refer to the Appendix (Page A-3) for a breakdown of the cost estimate.

It is also recommended that the corrosion of the submerged lifting loops be investigated further. NSB personnel indicated that some of the piles of the facility would be removed in the future as part of planned construction at the ARDM. NSB personnel suggested and it is recommended that these piles be examined to determine if the corrosion of the lifting loops is progressing into the pile, and to ascertain if the lifting loops were cast in contact with the mild steel reinforcement or the prestressing strands of the piles. After that inspection of the

interior of the piles is completed, an evaluation can be made as to whether cleaning of the piles, removal of the lifting loops and patching of the piles is required. It is recommended that, in the future, lifting loops be removed and the surface of the pile be patched during construction.

It is further recommended that the entire facility be reinspected at intervals of six years.

4.2 Spud Dolphin

4.2.1 Description

The spud dolphin portion of the ARDM was constructed in 1979. It is located adjacent to the pier portion of the ARDM facility in Kings Bay near its mouth at Cumberland Sound.

The spud dolphin is 270 feet long by 40 feet wide. It is constructed of 60 vertical and 103 batter, precast, prestressed, 24-inch square concrete piles with a cast-in-place concrete flat slab atop the piles. The dolphin was designed for a live load of 300 pounds per square foot. The water depth around the facility varies from about 30 feet on the shore side to 53 feet on the outboard side. Refer to Figure 4.2-1 for a plan and typical section showing the configuration of the structure. Refer to Photograph 4.2-1 for a general view of the dolphin.

4.2.2 Observed Inspection Condition

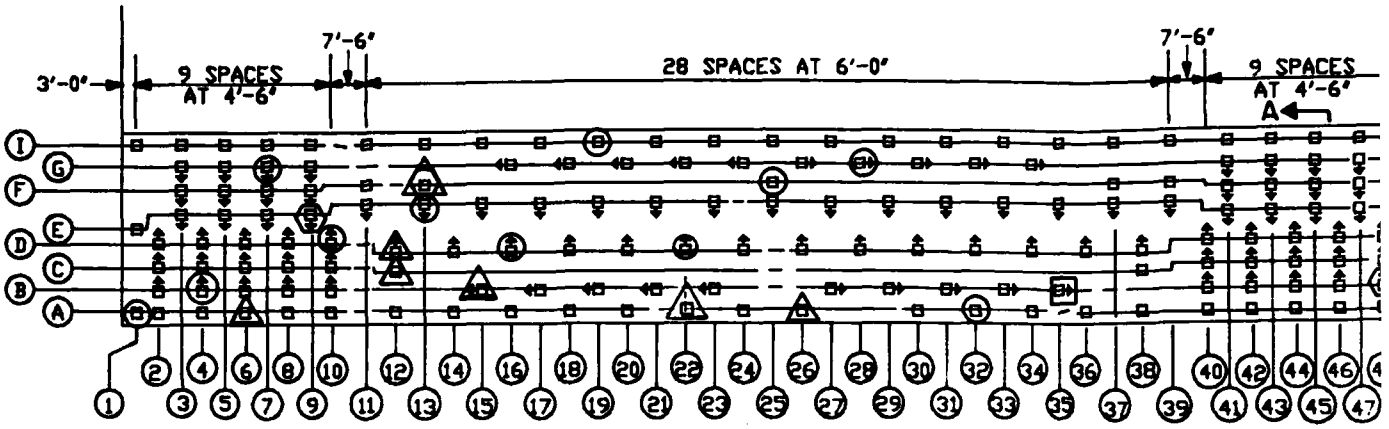
The prestressed concrete piles of the spud dolphin are in excellent condition underwater. No evidence of distress below water was found. During the inspection, wire rope lifting loops were found on three piles. These loops are corroding, and strands of some of the loops have broken due to corrosion. The location of the loops appears to be random, depending in part on the depth to which the piles were driven.

Above water, the piles were generally found to be in excellent condition. There were, however, a few minor areas of chipped corners and localized scaling. Eight piles, 6A, 12C, 12D, 13B, 15A, 22A, 26A, and 35B had minor, but measurable areas of chipped and scaled concrete. Refer to Page A-2 in the Appendix for a summary of the defects found during the inspection. Refer to Photographs 4.2-2 through 4.2-4 and 4.1-5 through 4.1-15 for underwater views of piles which are typical of conditions at the spud dolphin.

4.2.3 Structural Condition Assessment

The prestressed concrete piles of the spud dolphin are generally in excellent condition at this time. There is no damage or deterioration below water which warrants repair at this time. The cracked and chipped areas that were found above water are generally very minor. The areas of chipping and scaling noted on the eight piles noted above should be repaired as a part of future maintenance operations to prevent further deterioration. The other areas of deterioration noted during the inspection are so minor that no accelerated future deterioration is anticipated as a result of them.

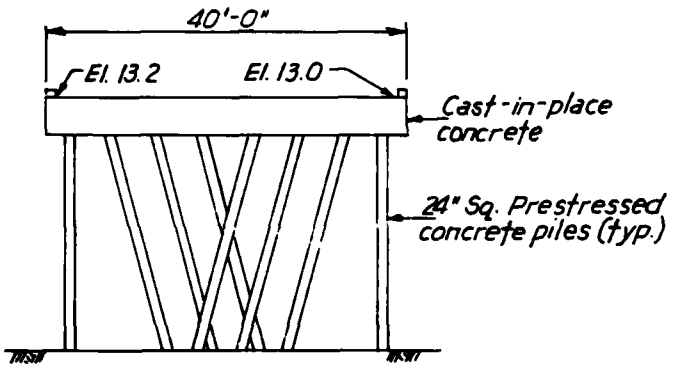
The corroded lifting loops that were found on some of the piles are not in themselves structurally significant, but they provide a path through which oxygen and moisture may enter the



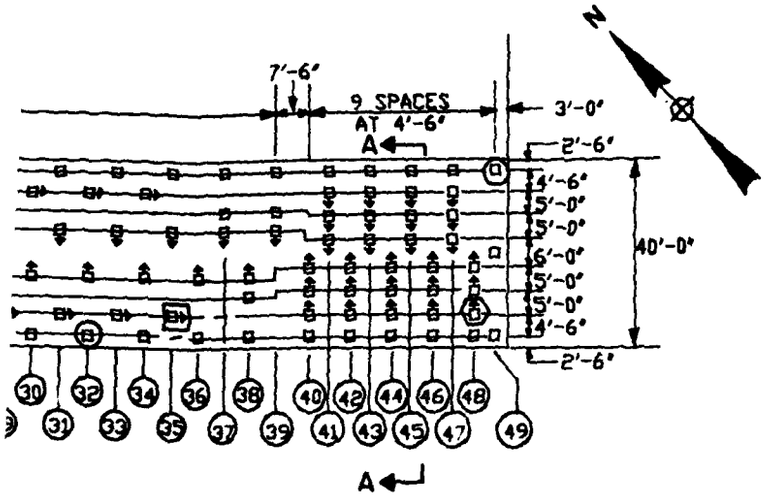
PLAN

Scale: 1"=30'

0 30 60



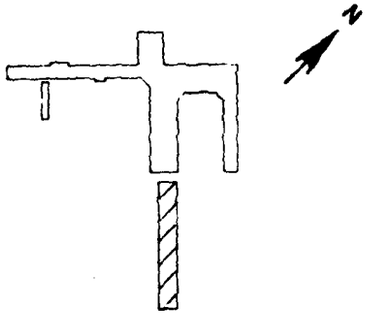
SECTION A-A



LEGEND
- Chipped Pile
- Scaled Pile
- Corroded Lifting Loop on Pile

GENERAL NOTES
Drawing developed in part from NAVFAC Drawing Nos. 5051728 & 5051732
All piles were given a Level I examination.
Piles marked thus ⓠ were given a Level II examination.
+ Channel water depths below M.L.W.

DESIGN LIVE LOAD
300# per sq. ft.



KEY PLAN

COLLINS ENGINEERS, INC.
CHICAGO, ILLINOIS

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C.

NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA

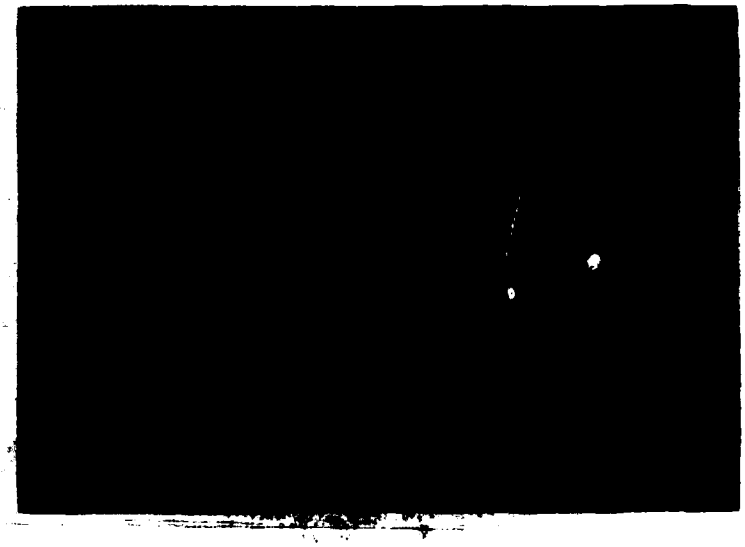
SPUD DOLPHIN

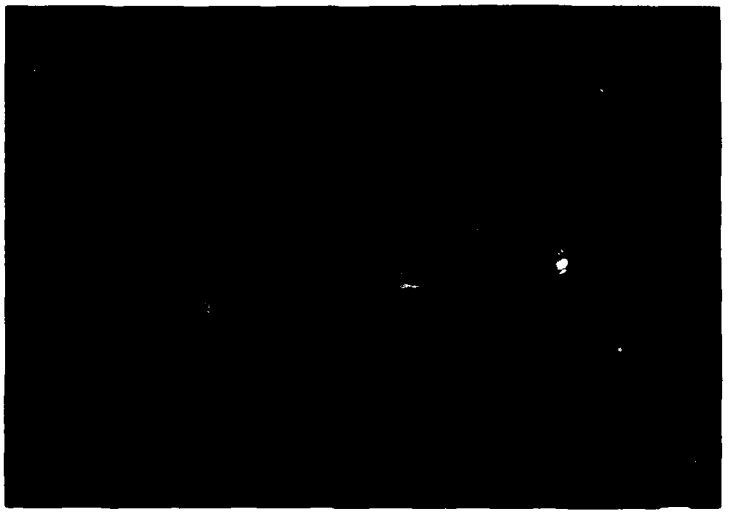
CONTRACT NO. N62477-69-C-0004

FIG NO. 4.2 -1

PHOTOGRAPH 4.2-1
Spud Dolphin, Looking East.

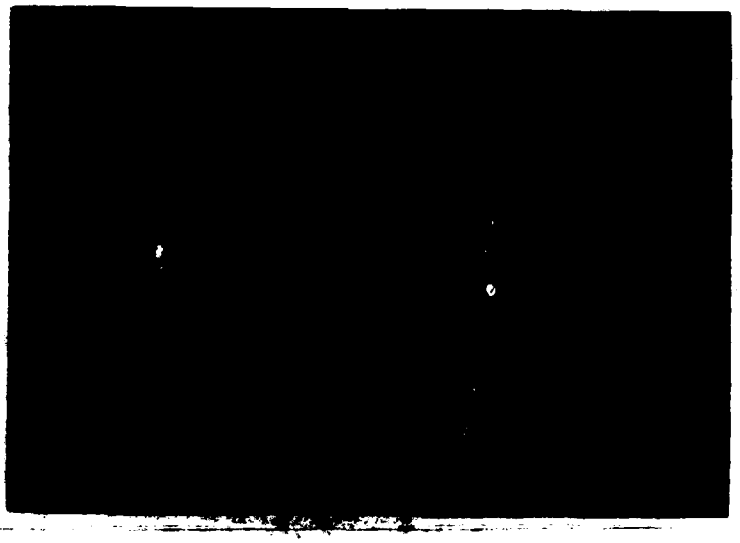
PHOTOGRAPH 4.2-2
Spud Dolphin Pile 1A, Elevation -2, Typical Pile Condition.





PHOTOGRAPH 4.2-3
Spud Dolphin Pile 1A, Elevation -10, Typical Pile Condition.

PHOTOGRAPH 4.2-4
Spud Dolphin Pile 1A, Elevation -20, Typical Pile Condition.



pile and establish an environment in which corrosion of the pile could eventually occur. It can be anticipated, from the number of lifting loops found during this inspection, that there may be lifting loops hidden beneath the marine growth on most of the piles. Their location, however, appears to be random, and extensive cleaning may be necessary to locate them. Severe corrosion is occurring to these lifting loops - probably due in part to the oxygen that is entrapped by the churning wash of tugs operating in the area.

Because the products of corrosion can occupy over ten times the volume of the original base metal and can develop pressures in the concrete in excess of 5,000 pounds per square inch, the corroding lifting loop, and corrosion of any mild steel reinforcement that may be in contact with the loop, could crack the pile and break off pieces of the concrete exposing the interior of the members to additional damage and deterioration.

4.2.4 Recommendations

It is recommended that the areas of scaling and chipping on Piles 6A, 12C, 12D, 13B, 15A, 22A, 26A, and 35B be repaired by patching with surface applied epoxy mortar. Prior to applying the mortar, any loose concrete should be removed and any exposed reinforcing steel should be cleaned. The estimated cost of these repairs is approximately $5,000. Refer to the Appendix (Page A-3) for a breakdown of the cost estimate.

It is also recommended that the corrosion of the submerged lifting loops be investigated further. NSB personnel indicated that some of the piles of the facility would be removed in the future as part of planned construction at the ARDM. NSB personnel suggested and it is recommended that these piles be examined to determine if the corrosion of the lifting loops is progressing into the pile, and to ascertain if the lifting loops were cast in contact with the mild steel reinforcement or the prestressing strands of the piles. After that inspection of the interior of the piles is completed, an evaluation can be made as to whether cleaning of the piles, removal of the lifting loops and patching of the piles is required. It is recommended that, in the future, lifting loops be removed and the surface of the pile be patched during the construction period.

It is further recommended that the entire facility be reinspected at intervals of six years.

ARDM FACILITIES

SUMMARY OF DEFECTS

PIER

Bent	Pile	Defect
29C	S Outboard	Pile corner chipped at pile cap in area 8 in. x 8 in x 3 in. penetration; rebar exposed;scaled area 8 in. wide x 2 ft high x 2 in. maximum penetration.
29C	R Inboard	1/16 in. wide crack 3 ft. long at pile cap.
27	A	Pile corner chipped at pile cap in area 2 in. wide x 8 in. high with maximum 2 in. penetration.
20	S Inboard & S Outboard	Each pile chipped on one corner at pile cap in area 1 in. by 1 in.
13	A	Slightly abraded corner in area 2 in. wide by 3 ft. long at Elevation -10.
12	I	Pile corner scaled in area 2 in. wide by 2 ft long near pile cap; 1 in. maximum penetration.
8	C	Steel "I" beam wedged against pile.
2	J	Hairline cracks 4 in. long on one side at pile cap.
1A	F West	Corroded lifting loop at Elevation -13.
	F East	Corroded lifting loop at Elevation -20.
1	B	Corroded lifting loop at Elevation -5.

ARDM FACILITIES

SUMMARY OF DEFECTS Cont'd

SPUD DOLPHIN

Bent	Pile	Defect
6	A	Scaling in area 3 in. wide x 3 ft. high x 1 1/2 in. maximum penetration near deck.
9	E	Corroded lifting loop at Elevation -10.
12	C & D	Pile corner scaled in area
15	B	1 in. wide x 3 ft high x 1 in. maximum penetration at deck.
13	F	Corroded lifting loop at Elevation -13; scaled area 1 in. wide x 2 ft high x 1 in. maximum penetration at deck.
22	A	Scaled area on one corner 1 in. wide x 6 in high by 1/2 in. penetration at deck; scaling on another corner in area 3 in. wide x 8 in. high x 2 in. penetration at 3 ft. below slab.
26	A	Scaled area 8 in. wide x 1 ft high x 1/2 in.penetration at slab.
35	B	Pile corner chipped in area 2 in. wide x 1 ft. high x 2 in. maximum penetration at 8 in. below slab.
48	B	Corroded lifting loop at Elevation -10.

REPAIR COST ESTIMATES

Repair cracks on 6 piles of Pier
and 8 piles of Dolphin

A. Mobilization and material	$4,000
B. Clean piles: 1 crew day @ 3,000	3,000
C. Apply Epoxy grout: 1 crew day @ $3,000	3,000
Total for Facility	$ 10,000

Because of small quantity of repair for each structure, cost may be apportioned equally between pier and dolphin:

Total for Pier	$ 5,000
Total for Dolphin	$ 5,000

END

DATE
FILMED

7-86